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Under the great leadership of the Chinese Communist Party, the Chinese people overthrew the old regime ten years ago and established the Chinese People's Republic. This enabled China's laboring people to forever free themselves from oppression and exploitation and step march on to the prosperous and happy road of socialism.

Under the leadership of the Chinese Communist Party, through diligent efforts on the part of the entire people, and with unselfish assistance from the Soviet Union and other brother countries of the socialist camp, gigantic achievements have been made in our fatherland's socialist construction during the past ten years.

The story of iron and steel, machinery, and coal fully tells the noted changes during the past ten years. Highest steel annual output in China prior to liberation was only 920,000 metric tons, and it was as low as 158,000 tons in 1949. Yet in 1958 the output of our "foreign steel" alone was 080,000 tons. Although we had some machinery plants prior to liberation, they were all in the nature of repair shops and accessory factories. There was no independent machinery industry to speak of. Now we have already established a foundation for modern machine-building industry. Heavy machinery, precision machinery, machine tools, aeroplanes, automobiles, tractors, etc. have all been produced. The highest annual coal output prior to liberation was 61,875,000 tons. On the other hand, our coal output in 1958 was 270,000,000 tons. Such a rate of development has never been seen in the history of any capitalist country and in this year of 1959 we will continue to further leap forward.

Following the large scale industrial construction in China, exceedingly rapid developments have also been made in technical sciences. From the standpoint of research organizations, only one research institute of technical science in

Academia Sinica was left by the old China. This was the predecessor of the Research Institute of Metallurgy and Ceramics. Since liberation, 17 research institutes of technical sciences have emerged under Academia Sinica, including the institutes of metallurgy, machinery, electrical engineering, power, coal, petroleum, civil engineering construction, hydraulics, electronics, and automation.

Different productive departments have also established their own research institutes. Polytechnical industrial universities and specialized engineering colleges all over the country also form a very large research force. In addition, provinces and municipalities are also setting up local research organizations. In the past decade, research institutes of technical sciences have been established one by one and an army of researchers is continuously expanding; basically, a scientific army of our own has been established. Of course, ten years is really a comparatively short period of time and our technical sciences are still in their youthful stage.

However, coordinating with the state's economic construction, we have done a great deal of work during these ten years and made many achievements. A brief intorduction on our achievements in technical sciences during the past ten years is made below.

MINING AND METALLURGY

Metallurgy is a field which has had a very rapid development in China. Whether in ferrous metals or in nonferrous metals, a preliminary industrial system from mining and ore dressing to refining and metal processing has been in existence.

In addition to the technical reconstruction of old mines, a group of modern mines has been established since liberation. In iron ores, manh large, medium, and small opencut mines have been newly established in the past few years. In 1958 ores from opencut mining already constituted over 90 percent of the total output. The annual capacity of large opencut mines has reached 5-7 million square meters.

In nonferrous metal mining, different mining methods suitable to different types of deposits have been studied, while mining by hydraulic power has been actively adopted in placers. Various technical and economic targets for mines have been improved each year. For instance, the highest monthly advancing rate attained in underground roadway development for a rock hardness of F = 10-15 and a cross section of 10.6 square meters is 429.7 meters. The sinking rate of a vertical shaft with a 6.1-meter diameter has also reached 103

meters per month.

Remarkable developments have also been made in ore dressing. The output of copper concentrates and that of lead concentrates in 1958 were scores of times higher than in 1949. Through the adoption of new techniques and the continuous study and improvement on new equipment and production flowsheets, the capacity of flotation mills has generally been improved by 10-20 percent and metal recovery has increased by 2-3 percent. In the alluvial tin mining areas, spiral separators have been extensively used in place of sluices as the preliminary ore dressing equipment. This has generally improved the recovery by 20-24 percent.

Full attention has been given during the past few years to the comprehensive utilization of complex metal ores both in research and in production. At present, not only molybdenum, pyrite, cobalt and magnetite associated with copper, lead and zinc ores are being utilized, but a high percentage of many other metallic oxides and sulfides associated with tungsten and tin ores is also recovered, thus increasing the types of products.

Starting 1953, the study for the comprehensive utilization of China's fluorite-bearing complex iron ores was started. A series of scientific research have been carried out from the standpoint of geology, ore dressing, smelting and refining, and the recovery of other useful elements. This has provided a scientific basis for the construction of new steel industry centers.

The strengthening of smelting and refining processes and the improvement of productivity have been indicated by a rise of the utilization coefficient of blast furnaces, open hearth furnaces, and electric furnaces. At the end of 1958, while the average daily iron output of China's large and medium blast furnaces was 1.487 metric tons per cubic meter of effective volume, that of the advanced Pen-ch'i Iron and Steel Company had already reached 2.4 tons. The average coefficient of open hearth furnaces is 7.81 tons of steel for every square meter of hearth area, but Shang-kang Plant No. 3 has achieved a record high of 13 tons. The average daily output of electric furnaces for every 100 KVA of transformer capacity is 22.56 tons; for the advanced Dairen Steel Plant it was as high as 30 tons.

In blast furnaces, high-pressure operations (the highest being 1.4 atmospheric pressure) have been employed in most of the large ones. In medium blast furnaces, the operating system of high blast temperature and high smelting intensity has been adopted, with the highest blast temperature reaching 1,080° C and the highest smelting intensity reaching

more than 1.5. For the existing open hearth operations, the policy of more charge, faster refining, and less stoppage is adopted, thus greatly increasing the utilization coefficient of open hearth furnaces. For instance, the method of three-trough steel discharge was introduced by the Taiyuan Iron and Steel Company. This is an important innovation in open hearth operation, which has raised the charge of the plant's open hearth furnace from 49 tons to 130 tons. By adopting this technique, the newly-built open hearth furnace of Anshan, the charging capacity of which can be raised to over 600 tons, becomes one of the largest open hearth furnaces in the world.

Steel refining by rotary furnaces has undergone a great development in China in the past few years. In adaptation to China's concrete conditions, tangential blast alkaline rotary furnaces have been used principally. This type of furnace has many advantages. The equipment is comparatively simple, and air blasting machines with high pressure are not required. Pig iron with a wider range of phosphorous content can be refined and the qualigy of product is also very good.

In the field of steel refining by electric furnaces, the use of exygen in 80 percent of the furnaces in 1958 greatly shortened the time for smelting and refining. In electric furnace steel refining, the "double-joining" method has also been adopted, such as the joining of a rotary furnace with an electric furnace. At the same time, the composite steel refining method has also been developed, whereby open hearth furnace is combined with electric furnace, electric furnace with electric furnace, and rotary furnace with electric furnace. In this manner, the quality of most of the steel output has been raised to the level of electric furnace product and the cost of superior quality steel has been greatly reduced.

In view of the special characteristics of China's resources, an alloy steel system of our own has been studied and established. The principal requirement in this work has been the saving of nickel and chromium. Through years of endeavor, we have adopted in large quantities such elements which are plentiful in China as silicon, manganese, vanadium, molybdenum, titanium, boron, etc. in many types of allow steel. In this manner, scores of new types of steel have been created, and the goal of saving nickel and chromium has been basically achieved.

Following the development in production, noted technical achievements have also been made in nonferrous metallurgy. For instance, the fluidized bed roasting method has been successfully applied to the zinc refining industry, and because of the successful high-temperature oxidizing roasting

of zinc concentrates, cadmium dust has been concentrated and the purity of cadmium has been raised. Fluidized bed roasting will also be applied to semi-oxidized roasting and sulfate roasting in the steel refining industry.

Aside from raising technical and economic targets and improving product quality, such associated metals as cobalt, nickel, cadmium, gold, silver, bismuth, selenium, tellurium, indium, and thallium have also been recovered in the different smelting and refining systems of copper, lead, and zinc. Studies have been made on the bydrometallurgy of copper oxide ores which are difficult to recover by ore dressing, and this has greatly improved the recovery of copper.

In the field of aluminum refining industry, China has an abundant supply of high silica aluminous ores and the major achievement in the production of aluminum oxide by sintering has been the change over to two stage extraction of prepared material (shu-liao). The ratio of caustic soda in sodium aluminate solution has also been lowered, thus basically preventing a second reaction and improving the actual recovery of aluminum oxide. In the electrolysis of aluminum, the low molecular ratio operation has been mastered in production. And on the basis of research results, magnesium oxide has been used in place of calcium fluoride as the additive, which lowers the melting point of the electrolyte and raises the current efficiency. In aluminum electrolysis techniques, an operation without anodic effect has been basically achieved and has subsequently improved production and efficiency.

MACHINERY

The rapid development of China's machine-building industry has not only completely changed the backward state of the industry itself, which was capable of only repair work and not independent manufacturing, but also pushed forward the technical reform in our national economy and created a material foundation for the industrialization of our country and the modernization of our national defense. The rate of development of the machine-building industry has been astonishing; the gross value of industrial production of 1958 was 41.6 times higher than that of 1949.

The development in heavy machinery and mining machinery has been most rapid. Currently, we have already manufactured 1,513 cubic meters of blast furnace equipment and large steel rolling mills, 2,500-ton hydraulic press, heavy duty crane and mining equipment, a complete set of 25,000-kilowatt thermal-electric generating equipment (including high-temperature, high-pressure boiler, turbine,

and hydrogen cooling turbine generator) and 72,000-kilowatt water turbine generator unit, high-efficiency and high-precision automatic and semiautomatic machine tools, as well as ocean-going vessels, locomotives, automobiles, aeroplanes, etc.

In respect to casting, cutting tools, turbine blades, and machine tool accessories have been manufactured with high precision, using the melting mould method, and very good results have been obtained. A clay mould is a type of semi-permanent mould and it has been traditionally used in a special casting method in China. In ancient times, people used it to cast three-legged metal urns, bells, and bronze wares. Through research and modification, this traditional mould has now been used in iron casting shops in place of hand-made sand moulds. As a result, labor productivity has been improved by more than three times. The range of use of this method is wider. From the smallest accessories of sewing machines to large iron castings, such as the cylinder of turbine engines and anvil blocks of air hammers, this method of casting has been employed. In addition, thin shell clay moulds have also been used for making such precision castings as machine tool gears.

In the field of heavy casting, the technology of making water turbine rotors (outside diameter 5,600 mm, net weight 45 tons) has been mastered, and the cross beam or girder of a 12,000-ton "tzu-yu-tuan" /literally, free forging/ hydraulic press has been cast. Special alloy high pressure containers have also been made by casting. While the working pressure can reach 320 atmospheres, 1,500 atmospheres have been reached in water pressure testing without any sign of leaking. In pressure casting technology, a new pressure casting machine has been designed and manufactured and the pressure casting techniques for light metals have already been mastered. Pressure casting for ferrous metals is now being carried out, and the study and design of high-pressure casting machines are being made.

A systematic study has been made on the heat treatment of spiroidal carbon cast iron. Its mechanical properties can already be initially controlled, and rollers for the preliminary rolling mill have been successfully manufactured. Crank axles and accessories of other internal combustion engines and machine tools have been produced in quantity. Results of study on the plasticity of spiroidal carbon cast iron prove that it can be rolled and forged.

In pressure processing, the study on hot rolling of gears has been carried out. Gears of third-class precision have been successfully rolled, and steel balls of 9-millimeter and 15-millimeter diameters and "double head" and

"single head" "ssu-kang" /literally, silk rod/ have been made by rolling. In large forgings, the hollow main-cylinder and vertical columns of 2,500-ton hydraulic press and the main axle and "yeh-lun" /the circular sections to which the turbine blades are attached/ of 100,000-kilowatt turbine have already been forged in China.

In machinery making, China has initially promoted ceramic cutting tools and has also studied cooling methods during the cutting process. For example, by high-pressure liquid spraying and carbon dioxide cooling, the life of the cutting tools is prolonged and the lustre of the processed surface is maintained. In addition, some work has also been done on the theories of cutting process.

Electric processing techniques have already begun to be promoted and applied in China. Such techniques include the anode machine grinding and cutting of hard alloy cutting tools, the processing of steel balls, drilling by electric sparks, surface hardening by electric sparks, metal cutting with electricity, etc. In order to strengthen electric processing work, an electric impulse processing machine tool has recently been successfully trial manufactured, and proved to be of great help to the processing of moulds and shapes.

In the field of welding, frictional welding of steel and nonferrous metals has been applied to the welding of cutting tools, conducting wires, and rods. It is already possible to apply electric slag welding to many large accessories. In addition, initial results have already been achieved in studing the use of different "tui-han" /literally, pile welding/ methods to make rolls, forging moulds, cutting tools, and wheels.

In precision optical equipment, high-precision instruments have already been successfully trial manufactured. They include an optical transit accurate to one second, universal microscope, large spectrometer, wide angle multi-arm projecter used in aerial survey, "chung-tzu yen-she-p'u-i," and electronic microscope. Actual production of most of these has already been planned.

In optical designing, certain characteristics of the formation of "kao-chi hsiang-cha'a" /literally, high level image difference/ have been explained and effectively applied to actual designing. As a result, a large object lense of F/0.8, and a "continuous focal changing lense" of F/2 with a viewing range of 40 degrees (maximum viewing range up to 60 degrees) and a "focal change ratio" of 1:5 have been designed.

In addition, China has also established industries of precision measuring devices and roller bearings. Products

representing the technical levels achieved include "liang-ku'ai" /literally, measuring piece/ for electrode standard and precision bearings for meters of "ling-chi" /literally, zero pole/ accuracy.

MOTIVE POWER AND ELECTRIC POWER

Because of needs of motive power in communications, transportation, industrial production, rural areas and national defense, significant achievements have been made in China in the study, designing and manufacturing of different types of internal combustion engines. And we have now gone a step further to carry out the trial manufacture of 8,800-horsepower high efficiency diesel engines. Research and development in coal gas during the past few years have had a great effect upon highway transportation, inland river navigation, and rural irrigation. Developments in motive power industry have pushed ahead basic research work in the science of motive power. Research work has been started and many achievements have been made in thermodynamic motive power machinery, fluid mechanics, thermal conductance, combustion, strength of machinery and vibration.

In a short period of 10 years, more than 10 new electric power networks of different sizes have been established, the larger ones having reached 1 million kilowatts. As a result of the rapid development of power systems, stabilization and automation in power systems have become very urgent. The double frequency, phase comparison type high-frequency relay protective equipment, which has been successfully trial manufactured, has already been successfully adopted by the Northeast power system. The study of power system frequency and effective power regulatory work has already begun in China. In order to control power systems at a remote distance, different models of remote measuring and remote control installations and high-frequency communication installations have been studied and trial manufactured. Experimental research on the use of internal hydrogen cooling and liquid cooling of electrical equipment has been started, and models of electrical equipment of different capacities have been trial manufactured and tested.

Together with the installation of step-up transformers and high voltage transmission lines, research on atmospheric over-charge protection and internal over-charge protection has been started. In high voltage power equipment, complete sets of high voltage power equipment of 220 kilovolt type have been successfully trial manufactured.

The highest capacity of power transformers has reached 60,000 kilovolt-amperes. At the same time, the manufacture of oil-immersed and air types of circuit breakers is under study.

FUELS

The volume of coal output in 1958 reached 270 million metric tons in China. Based on the work of geology and coal chemistry, a plan for different types of coal has been drawn up. This has a great significance to the planned operation of coal mines, their utilization, the balanced coal consumption in different areas, and transportation. In order to improve the quality of blast furnace fuel, very good results have been obtained in the study of methods of preheating coking coal. Preheating not only increases the amount of coal per charge but also improves the cohesion of coal, which is favorable to the improvement of the quality of coke.

In the designing of coke ovens, the model 58 bottom spraying type ("hsia-p'en-shih") coke oven has been developed. It possesses the special characteristics of low investment and fast construction, and therefore meets exactly the requirements for the rapid development of the iron and steel industry.

At the present, coal is primarily used as a fuel, but the study of its other uses has received special attention. The low-temperature dry distillation of coal is a process that is being energetically promoted in the coal industry for oil refining. In a matter of 3-4 years, the construction and production techniques of bituminous coal three-stage internal heating low-temperature dry distillation ovens have been mastered, and the operational capacity has greatly exceeded the capacity originally designed. The process of "cohesion destruction" by oxidation during the drying stage has also been mastered, thus increasing the types of coal as a raw material.

Through extensive experiments on square dry distillation ovens and gaseous combustion process, the advantages of simplicity in construction, good thermal effect, and high oil extraction rate have been obtained. Initial results have been obtained in the study for the extraction of internal combustion engine fuel and chemical raw materials through medium-pressure hydrogenation of coal tar oil. Additionally, in connection with low-temperature dry distillation, studies have been carried out on the comprehensive utilization of products and on the increase of sources of raw materials. All this work has been of assistance to the development of

China's coal-for-oil refining industry.

A fine beginning has also been made on the research work for new methods of thermal processing of coal. This work has been primarily to coordinate thermal pressure coking experiments on coal of poor cohesion with the dry distillation of solid heat carriers of coal used by thermal-electric plants and the "fluidized" dry distillation of powdered coal, the gasification of coal by pressure, the underground gasification of coal and oil shale, etc.

Petroleum is one of the most important fuels. It is also the primary source of lubricating oil and basic raw materials for the chemical industry. In coordination with the development of China's petroleum industry, a standard method of evaluation of crude oil and products was established. Evaluation, analysis and the study of refining processes have been carried out about the major resources of natural petroleum and shale oil, providing basic data for plant expansion and construction.

In the development of petroleum refining techniques, the platinum treatment technology and the preparation of catalysts have been successfully studied and the technological study of the treatment process and the separation of products has been completed. This result will soon be applied to production. The alkylation process and the urea dewaxing process have been developed and a pilot workshop has already been established. The manufacture of an alkene "tieh-ho" /literally, overlapped or joined together/ catalyst of good properties is now being studied. And the study on many types of catalytic and cracking processes and on catalysts has been started.

In shale oil industry, the treatment capacity of dry distillation furnaces has been increased by 10-15 percent over that before liberation on a single furnace basis, and a noted improvement has also been made in the oil extraction rate. In industrial production, the high-pressure hydrogenation process of the coal tar fraction of shale has already been mastered, and a good property catalyst through hydrogenation refining has been developed. From the initial results achieved in the study of the "fixed bed" hydrogenation process in total fraction of shale oil, transformer oil can now be produced.

In water gas synthetic fuel, a new process of molten iron catalyst liquid synthesis has been developed and high activity catalyst has been produced; a product extraction rate of 191 grams per cubic meter of carbon monoxide plus hydrogen has been reached. In lubricating fats and oils, many kinds required by China's machinery industry have been studied and produced by the use of domestic raw materials.

In coordination with research in petroleum refining, studies have also been carried out on such related problems as catalysts and catalytic reactions, chemical separation, and the designing theories of reactors. These studies have had a definite significance to the solving of practical problems and to improving our level of understanding of scientific theories.

WATER CONSERVATION

The fundamental elimination of flood disasters and the development of water conservation comprise an important task of the Chinese people. Because of the negligence of water conservation work prior to liberation, the laboring people in large areas regularly suffered from disasters of flood, drought and waterlogging. After the entire country was liberated, the Party and the People's Government have paid a great deal of attention to water conservation work, and very important achievements have been made. A series of large, medium, and small water conservation projects have been repaired and constructed in China during the past decade. For example, irrigation and hydroelectric undertakings have been developed, the threat of flood has been reduced, and river basin planning or initial development plans have been completed for most of the major rivers in China.

In concrete dams, China has constructed various types of gravity dams and light dams, such as "large head" dams /possibly, same as gravity buttressed dam/, arch dams, continuous arch dams, "flat plate" dams, and plant type structures inside dams. At the same time, large numbers of rock fill dams have been constructed and large flood gates have been built on soft earth foundations. All these are indications of the growth and the standard of China's water conservation science. The scientific research work in water conservation developed as a result of the fact that these construction projects has had a definite significance in providing basic information and scientific data, in guaranteeing engineering quality, in speeding up the rate of construction, and in lowering the cost of construction.

Hydrography work in China has had an important development in this era when political power is in the hands of the people. Basic stations and networks of hydrography had been fundamentally completed in most of China's provinces and regions (except for the border areas) by the end of 1958. Data collected in the past have already been edited and published in the form of hydrographical yearbooks. On the basis of these data, equal-value line maps of such hydro-

graphical factors as storms, annual precipitation, and annual run-off for the major regions of China have been completed. Based on the hydrographical characteristics of China's rivers, the work of hydrographical calculation has been developed, especially the method of calculating floods. On the basis of the equal-value line maps of the above hydrographical factors, different methods of hydrographical calculations, and hydrographical statistical data of different areas, most provinces and regions have published their own hydrographical handbooks, which provide a basis for the planning and designing of water conservation projects in these different areas.

Aimed at the problem of building large hydraulic conservation centers on China's rivers containing large quantities of silt, like the Yellow River and others (for instance, the average silt content of the Yellow River throughout the year is 32 kilograms per cubic meters), the problem of "differential gravity flow has been seriously studied. On the basis of field data of differential gravity flow of Kuan-t'ing and other reservoirs and laboratory experiments, the formation of differential gravity flow and the rules of transmission and discharge of mud and silt have been basically understood and mastered. On this basis, a proposal has been made to lower the height of the sluice openings of the San-men Gorge by 20 meters in order to facilitate the discharge of mud and silt and thus prolong the life of the reservoir. Furthermore, in the study of water flow in the cooling tanks of thermal-electric stations, the so-called law of movement of differential gravity flow due to difference in temperature has also been preliminarily discovered.

To coordinate with the construction of different types of water conservancy structures, large numbers of experiments have been done.

As a result of these experiments, many proposals for improvements in designing have been made and the quality of construction has been improved. Lately, with the construction of high dams, testing work for high waterhead hydraulic centers and large hydroelectric stations is gradually assuming a greater significance, and research work on fundamental theories concerning high-speed water flow has also been actively pursued and developed. Definite results have also been obtained in the study of energy dissipating measures, hydraulic problems in waterways and high-pressure valves, the problem of air inclusion in high-speed water flow, and the problem of pulsating motion of water flow on spillway slabs and "force dissipating" pools.

In the stress analysis of high dams, polarized light

elastic, printed corss-section, and light stone mortar material model testing methods are now being adopted. Developments have also been made in the calculation of temperature stresses of concrete dams. To study the possibility of pouring high sections of concrete, field testing and research work at working sites has been carried out.

Considerable progress has also been made in the technique of constructing earth dams as a result of the building of large numbers of earth dams of different heights in China. Up to the present, the most commonly used type of dam is the compacted and rolled earth dam. The method of dam construction by placing earth fill in water has recently been adopted. In the building of rock fill dams, fixed direction blasting with huge quantities of explosives has also been successfully applied.

A great deal of experience has been accumulated in the construction sluice gates on soft foundations. Methods of treatment of soft foundations by precompressed sand piles, concrete sheet piles, and grouting have all been successful. In addition, some theoretical study has also been carried out on "tien-shen" [literally, electric seepage] water drainage.

Water conservation and soil improvement are very important in China. On the basis of the experience acquired by the farmers during the past ten years, an unique irrigation system has been established in China. The characteristics of this system include water retention and channeling water uphills and up to plateaus in mountainous and hilly regions, and river networks for both retention and discharge on plains. The method of salt washing by rice planting has been successfully utilized in improving salt and alkaline earth, and the testing of this method has been successfully carried out in the "paichiang" earth area of Ningsia Province.

CONSTRUCTION ENGINEERING

Capital construction work on a tremendous scale has been going on in China. Not only have construction tasks been completed, but standards of scientific techniques have also been improved. Construction engineering has stepped onto the road of industrialization with large-scale adoption of prefabricated reinforced concrete structures. Prestressed concrete structures have made very rapid developments and they have been widely applied in different places and to different types of buildings. Currently, research on the use of large prestressed concrete structures is being

actively carried out in order that steel may be saved. Already successfully trial manufactures are 60-meter span roof trusses, crane girders of 75-ton lifting capacity, railway bridge girders of 32-meter span, etc.

The total output of prestressed concrete in 1956 was 1,000 cubic meters, but in 1958 it had risen to 80,000 cubic meters. Reinforced concrete thin shell structures have been adopted in long span civilian buildings. More More commonly used are circular column shaped long shells, currently the longest span of these shells being 55 meters. Double curvature flat shells have also been used.

The study on construction material substitutes has been extensively carried out, such as bamboo in place of timber, reinforced bamboo and glass fibres in place of steel reinforcements, cement without prepared materials ("shu-liao") [possibly, uncalcined cement] in place of ordinary cement, and silicate materials in place of concrete, and results have been attained under definite conditions. The so called "four-none-use" buildings, which use glass fibre silicate structures and silicate blocks as load bearing members, were constructed in Harbin and Peiping. This type of building singly demonstrates the significance of research in this field.

In building designing methods, standardization has been gradually achieved through large-scale adoption of standard designs in order to greatly speed up the rate of designing. The designing of a 1,500,000 metric ton iron and steel combined enterprise now requires only one year to complete.

In structural calculation work, Soviet methods based on "breaking stage" and limiting state have been adopted with very great economic results. Comparisons show that in the designing of reinforced concrete 30-50 percent of steel can be saved when calculation is based on the "breaking stage" rather than the previously used method of permissible stresses. And another 5-12 percent can be saved when calculation is based on limiting state.

The completion of such difficult projects as the Paochi-ch'engtu Railway, Yingt'an-Amoy Railway, and the Wuhan Yangtze River Bridge signifies the overall development in China's railway techniques. The section of Pao-ch'eng Railway which corsses the Ch'in Ling Range demonstrates the technique and ingenuity of line location at high altitudes. An excavation project of 260,000 cubic meters of rocks and earth at the Ch'ing-shih-yai station was successfully completed by a single fixed direction blasting. These accomplishments will have far reaching influences on future railway line location and construction.

The Wuhan Yangtze River Bridge is a crystallization of Sino-Soviet cooperation. The "reinforced concrete pipe column foundation" method developed as a result of this project represents an important improvement and revolution in deep water foundation construction. Because of this new method, underwater work is avoided, no complicated construction machines and tools are required, and construction is not affected by riverbed geology and floods. Developments in the technique of pipe column foundations are now continuing, and we are now capable of sinking pipe columns as big as 5.8 meters in diameter into different types of complicated overlying strata.

A series of studies have been made on the special characteristics of loess in the northwest, North China, and northeast regions, and such important characteristics as its composition of chemical minerals, particle composition, subsidence, plastic deformation, and natural strength have been initially clarified. This has an important significance to the work of construction in the large loess regions.

With regard to the study of clay adhesion, the "sanwei" theory of consolidation which takes into consideration the plastic deformation factor, has been established. This clarifies the point that the secondary time-effect on consolidation of clay soil is the result of its plastic deformation property. The plastic deformation phenomenon of clay has also been explained from its micro structure.

SILICATES

Many types and many grades of cement are produced. Prior to liberation, only one kind of silicate cement was produced in China, but now 21 kinds are produced, including silicate cement, quick hardening cement, and aluminous cement. With the development of the cement industry, the sources of cement raw materials have also expanded. For instance, certain limestones of higher magnesium oxide contents as well as minerals containing anhydrous gypsum and clayey gypsum have been rationally utilization. Blast furnace slags have been used in large quantities in the preparation of crude materials and as mixing materials; residues of aluminum oxide extraction can be used in the manufacture of uncalcined cement and to replace a part of the limestone and the clay entirely in manufacturing silicate cement; and residues from oil shale refining are used as activating mixing materials and lime-volcanic ash cement. Additionally, in order to increase the uses of cement, attention has been given to the development of

cement products. For example, large-scale production has been carried out for such items as cement electric poles, concrete water pipes, asbestos cement tiles and boards, and asbestos cement water pipes.

In the field of refractory materials, superior quality refractory products have been developed in accordance with the special characteristics of China's resources. For instance, high aluminum alumina which is found in large quantities in China has been successfully used in the making of high alumina bricks which in turn have been successfully used as covers of electric furnaces and in building the water jackets of open hearth furnaces. Another example is the successful trial manufacture of magnesium-aluminum bricks, using spinel as the binding material in view of China's shortage of chromite ores. The physical and chemical properties of this brick when used in the crown of open hearth furnaces are superior to chrome-magnesium bricks. In order to solve the problem of corrosion against blast furnace refractory materials during the refining of fluorine-bearing iron ores, the mechanics of corrosive action against furnace lining at different sections of the blast furnace by different types of fluorides have been studied, thus providing a basis for the selection of furnace lining materials.

In the production of refractory materials, very important improvements have been made in firing techniques. For instance, in 1958 the Chungking Iron and Steel Company adopted different measures for the rapid firing of clay bricks, enabling the firing time of refractory materials to be reduced from the original 60-90 hours to 8-9 hours and increasing the productive capacity by 2-3 times. This was an important innovation in productive techniques and the experience has received very rapid promotion in the different refractory material plants of China. At the same time, similar measures were adopted in the refractory material plants of Pen-ch'i and An-shan steel works to reduce the time needed for the firing process of silica bricks.

Many results have also been obtained in the field of optical glass and special types of glasses. China is already capable of producing optical glass of different properties, and a number of types of rare earth optical glass have been produced.

Because of the government's interest and concern in ceramics and porcelain, a Porcelain Manufacturing Committee for National Construction has been specially established to carry out investigations and studied on raw materials, moulds, glaze preparations, and firing in the Ching-te-cheng area, and results have been attained in the rehabilitation

and improvement of China's traditional fine porcelain wares. Very important developments have also been made in industrial ceramics and porcelain, such as high-voltage porcelain, "kang-yu-tz'u-tao" [some kind of porcelain knife], chemical ceramics and porcelain, and high temperature ceramics and porcelain.

RADIO ELECTRONICS AND AUTOMATION

China has achieved very rapid developments in telecommunications during the past ten years. With the capital as the center, a national telecommunication network is rapidly developing in the direction of greater perfection, greater flexibility, and higher efficiency. The largest radio transmitter has reached many tens of kilowatts. New radio stations can transmit "i-p'ing" [literally, moving frequency] telegrams and "tan-pien-tai" [literally, single side taped] telephone calls.

On the national trunk lines, 8-line and 12-line wave carrier telephones have been widely adopted, and microwave relay communication equipment has begun to be used. In telecommunication equipment, China has begun to trial manufacture 60-line wave carriers and 30-line microwave machines.

A national broadcasting network (including wireless and wire broadcasting) has been established, and television broadcasting has begun. Some technical problems have been solved through research and actual work. For instance, in sound quality, there was not a single broadcasting room prior to liberation which met the technical requirements of sound quality. Now we are doing our own designing and testing of accoustic materials and regulating our sound quality standards, and modern broadcasting studios are gradually being established in different places.

In broadcasting, the comparatively new technique of three dimensional sound has already begun to be used, and such comparatively new parts as "sound columns" and "sound couples" have been used for stadium loudspeaker systems. In large broadcasting transmitters, the automatic "pan-chi t'iao-fu" circuit used in the Soviet Union has been widely adopted, resulting in improvement of efficiency and electronic tube utilization rate, and the speeding up of the construction of radio stations. And "li-hsieh" and other methods have been used to improve the working efficiency of transmitters.

In aerials used in broadcasting, many new types such as the wide-band horizontal "same phase" antenna have been widely employed with good results. In medium wave length work, light steel towers have been used in making different types of directional and non-directional "shuai-lo" aerials.

Compared to the old steel towers, 3-5 times of steel has been saved. Some medium- and short-wave stations have adopted the method of having two transmitters sharing one aerial, which saves both investment and ground.

The microwave equipment industry has been gradually established during the past decade. Definite results have been achieved in the trial manufacture of microwave measuring instruments, radio-electronic telescopes, microwave electronic gyrating accelerators.

Because of the requirements of atomic energy, electronic computer, multi-line communication, and other scientific techniques, impulse techniques have received greater attention. We have produced a "ch'u-fa sao-miao" circuit suitable for atomic energy research. Used for observing impulses in atomic radiation detectors, this circuit may avoid overlapping and confusion. A very good linear and extremely slow "sao-miao" circuit has also been used in wave indicators to observe slow changes in geophysical and electro-physiological tests. Initial results have also been attained in efforts to make a basic circuit for producing micro-second impulses, and amplifying effect.

The electric vacuum parts industry was also established after the liberation. In addition to the ordinary electronic tubes, "ch'un-ch'i-fang-tien-teng" /gas filled electric discharge light/, radiation tubes, and electronic beam tubes, research and small-scale production of microwave tubes and crystal tubes has also begun.

In the field of automatic controls and remote operation, continued progress has been made in order to satisfy the requirements for the rapid development of China's modern industries. New achievements in automatic controls during the past few years have also already been applied to metallurgical, steel rolling, power, chemical engineering, and textile industries. Needs in actual work have brought about the development of theories of automatic controls in the "to-tung" /conveyor/ system for seeking the best transient process ("kuo-tu kuo-ch'eng") and a c omposite transportation system.

Since 1956 we have trial manufactured different types of electronic computing equipment, and some of them have already been applied in the designing work of control systems. To meet the needs of power systems, the research and trial manufacture of different types of remote measuring and controlling equipment have been carried out, including the recently trial manufacture of a comprehensive remote operating equipment constructed with non-contacting parts.

China has now produced many automatic instruments and tools, such as meters for measuring and controlling of

temperature, pressure, flow, and chemical composition. Since 1958 we have started trial manufacturing standard meters, and have thus laid a good foundation for the large-scale production and use of measuring instruments. We have also started the trial manufacturing of unit component type of air-operated and electronic instruments with considerable achievements. These instruments, are indispensable parts for the complete automation of industrial systems.

Although very great developments have been made by China in technical sciences during the past decade, they are still far from being able to meet the needs of national construction. From the standpoint of world technological, standard, China is still comparatively backward. This means that we must further exert ourselves and humbly learn from the Soviet Union and other fraternal countries.

China's technical sciences have been established as a result of its socialist construction and they will rapidly advance with the continued development of China's socialist construction. Under the great leadership of the Chinese Communist Party, all Chinese scientific workers are contributing with confidence their wisdom and strength to the task of socialist construction of their fatherland and striving for the advancement of their fatherland's scientific undertakings.

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